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STATUS OF RICE IMPROVEMENT IN THE PHILIPPINES [1]

D. L. UMALI [2]

WITH ONE TEXT FIGURE

As early as 1911 rice improvement by selection and breeding was undertaken by Filipino plant breeders and since then, a number of improved varieties of both lowland and upland rice have been produced. But since government support for this work had been generally occasional and inadequate, the work had little impact on the lives of farmers. In fact it suffered a serious setback during World War II when varieties became mixed-up and seedstocks of the improved varieties were lost. Rice improvement work was given a boost soon after the arrival of Dr. Loren L. Davis of ICA in January, 1952 and of Dr. H. K. Hayes of the Cornell Group in the College of Agriculture, University of the Philippines, in August of the same year. To make effective progress in this undertaking, the College of Agriculture, the Bureaus of Plant Industry and Agricultural Extension, with the assistance of ICA, Manila, started the cooperative rice and corn improvement program in 1952, the objective of which is to breed and produce for distribution to Filipino farmers superior varieties of rice and corn. The cooperative program was formalized by representatives of the four organizations in 1954 when a memorandum of understanding was signed and project outlines for the improvement, production and distribution of rice and hybrid corn were drawn. The U. P. College of Agriculture and the Bureau of Plant Industry assume the responsibility of selecting and breeding new varieties, conducting general and regional tests and providing foundation seed of superior varieties for increase and distribution. This program has so expanded during the past years that at present agricultural high schools and colleges and private firms cooperate in conducting yield tests in the different rice regions of the Philippines. Foundation seed is grown and multiplied as registered seed at the Seed Farms and Experiment Stations of the

[1] General Contribution No. 882. Read before the Joint Meeting of the FAO International Rice Commission held at Vercelli, Italy, September 23-28, 1957.

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Bureau of Plant Industry. Registered seed is sold by the Bureau of Plant Industry to qualified and progressive farmers chosen by the Bureau of Agricultural Extension for the production of certified seed. Production of certified seed is supervised by certified seed supervisors of the Bureau of Agricultural Extension. Field inspection of seed samples for certification by the seed laboratory of the Bureau of Plant Industry and tagging and sealing of rice bags are done by the certified seed inspectors of the Bureau of Plant Industry. The Agricultural Credit and Cooperative Financing Administration (ACCFA) and the National Rice and Corn Corporation (NARIC) assist in the storage and distribution of certified seed to the farmers.

A Seed Board composed of the Dean of the College of Agriculture, the Director of the Bureau of Plant Industry, the Director of the Bureau of Agricultural Extension and two members from each of the three government agencies was created on March 11, 1955 under Special Order No. 616 of the Secretary of Agriculture and Natural Resources. The Seed Board passes upon and approves recommendations for increase and distribution of improved varieties. No variety or hybrid may be increased, certified or distributed to farmers unless approved by the Seed Board.

PHASES OF THE PROGRAM

1. *Introduction and observational plantings of rice varieties.* To evaluate rice varieties from among the large number of available ones in the Philippines as well as throughout the world, the College of Agriculture and the Maligaya Rice Experiment Station have been collecting rice varieties and have been growing them in observational nurseries to study their agronomic characters. In five years, more than 900 local varieties and 2,362 varieties of the world collection have been grown and screened in observational nurseries for promising ones adapted to the lowland conditions to find out which of them are sensitive to short days and to determine the best time of planting for the sensitive ones. They are also being studied for special characteristics which may be useful for breeding purposes such as short stiff straw and absence of seed dormancy. Many of the upland varieties performed well under lowland conditions. From among them, high-yielding and dual-purpose varieties were selected.

2. *Varietal evaluation, purification and multiplication.* In five years, 1953-1957, performance trials of commercially grown rice varieties and those promising in observational nurseries (300 upland and 420 lowland) were conducted in 14 different stations of the coun-

try. As a result of these trials 23 upland and 11 lowland varieties have been recognized as promising and the Seed Board has recommended that they be purified and increased. However, only seven lowland and seven upland varieties were approved for certification and distribution to date. To supplement this testing and so that specific variety recommendations may be made for each province, demonstration trials in farmer's fields are now being conducted for both upland rice and hybrid corn. These demonstration trials, which are under the direct supervision of the Municipal Agriculturists, will be conducted in at least 6 to 10 municipalities of each of the 21 rice-producing provinces of the Philippines in the near future.

The College of Agriculture and the Bureau of Plant Industry assume the responsibility of purifying all varieties recommended for increase by the Seed Board. Every year the College of Agriculture and the Bureau of Plant Industry supply the Certified Seed Program with about 150 kg. of Foundation Seed of each variety approved by the Seed Board. The same amount of Foundation Seed is kept in stock in a seed cold storage room so that in case of any calamity such as crop failure, seedstock will still be available for planting.

3. *Production, certification, and distribution of seed.* The production and distribution of seed is of paramount importance in a national crop improvement program. Unless this phase of the program is effective, the work which goes into the breeding of new strains and the testing for their range of adaptation will be largely wasted. In many countries, this is the weakest phase in the crop improvement program.

Three kinds of seed are produced—Foundation Seed by the College of Agriculture and the Bureau of Plant Industry, Registered Seed by the Bureau of Plant Industry and Certified Seed by private farmer cooperators.

The seed certification agency of the BPI was organized to regulate the purity and quality of certified seeds that are sold to the farmers. The Central Seed Laboratory of the Bureau of Plant Industry is located in Manila. Two branch seed laboratories, one in Central Luzon and another in the Visayas will soon be established to cope with the increasing number of seed samples being submitted for analysis.

As provided for in its memorandum of understanding with the Department of Agriculture and Natural Resources and the College

of Agriculture, the Agricultural Credit and Cooperative Financing Administration (ACCFA) which has cooperatives all over the country is committed to sell at a minimum price new bags to contain the certified seed of farmer cooperators, haul the seed to warehouses of the cooperative, and the moment the seed is stored in the warehouses, give the farmer cooperator a loan equivalent to 80 per cent of the value of the seed. The cooperative helps sell the certified seed to farmers.

The National Rice and Corn Corporation buys the certified seed of the farmer at the commercial price of rough rice. Then after the farmer has shown that his crop was certified by the Seed Laboratory of the Bureau of Plant Industry, the National Rice and Corn Corporation pays the price difference between the certified seed and commercial rough rice. The National Rice and Corn Corporation sells these certified seed to other provinces without seed producers.

4. *Breeding of better strains.* F_5 lines of indica-japonica crosses supplied originally by FAO were grown and tested for yield and standability under upland conditions at the College of Agriculture and under lowland conditions at the Maligaya Rice Experiment Station of the Bureau of Plant Industry. Four high-yielding strains which are resistant to lodging under upland conditions and eight high-yielding strains under lowland conditions will be included in the general test next year. Other hybridization work is also underway to combine desirable characters from several varieties as a basis for selecting future strains better than those now available. Milfor 6, a locally developed hybrid highly resistant to lodging, has been crossed with all important upland and lowland varieties to combine its standability with the desirable characters of other parents.

ACCOMPLISHMENTS

1. *Varieties according to standability grouped.* From the results of our observational plantings and variety tests at different stations, it is now possible to group the commercial upland and lowland varieties according to their resistance to lodging. This information is important because it gives us better insight on how to fertilize different rice varieties. The results of our experiments indicated that the ability of the varieties to respond to fertilization depends on their capacity to stand up under heavy fertilization.

2. *Season-bound varieties determined.* Another important contribution is varietal classification according to sensitivity to short

days. Most of the varieties grown commercially by farmers will not mature until exposed to the short days of December and January and are not satisfactory except when sown at the proper time. This information has been obtained from bi-monthly plantings of commercial varieties of upland and lowland rice throughout the year.

3. *Early- and dual-purpose varieties selected.* The program has selected three early- and dual-purpose varieties and two early lowland varieties which mature in less than 145 days and which yield significantly more than the many late-maturing varieties that are generally grown. This finding is contrary to the predominant belief of many farmers that late-maturing varieties like Wagwag (210 days), Elon-elon (185 days) and Raminad (180 days) are generally better yielders under certain conditions such as when there is plenty of water or when planted on soils where rice does not usually lodge. For rain-fed fields which constitute 60 per cent of our rice acreage and which do not have enough water to mature a late-maturing variety, the high-yielding and early-maturing varieties are better. Varieties that are early, non-sensitive to photoperiod and dual-purpose, make possible the growing of two crops a year on rain-fed fields—upland rice from May to September, and when there is enough rain water for land preparation, a second crop may be grown from November to mid-March. With these early varieties it is possible to grow a crop of rice and a green manure crop or a rice crop and a cash crop like mungo or soybean. Tjere Mas, one of the recommended early-maturing varieties is resistant to root rot—a widespread and serious disease in Central Luzon, the Bicol Region and Masbate.

4. *Undesirable commercial varieties determined.* Based on the results of the cooperative trials, it was possible to recommend the discarding of 86 commercial varieties due to poor milling recovery, chalky endosperm, red kernels, susceptibility to major pest and diseases like blast, bacterial stripe and root rot.

5. *Recommended rice varieties for multiplication, certification and eventual distribution to farmers approved.* Based on the performance of many varieties for five years at different stations in the Philippines, the Seed Board approved seven upland varieties and seven lowland varieties for multiplication, certification, and distribution to farmers. These varieties on the average outyielded those generally grown by farmers by about 23 per cent.

6. *Varieties classified.* To minimize the nomenclatural confusion of rice varieties in the Philippines, a start has been made on the classification of varieties. The available indigenous varieties and those introduced from foreign countries have been studied and tabulated. A guide to distinguishing characters of the varieties recommended by the Seed Board was prepared and published for the use of certifying agencies, certified seed inspectors and supervisors and farmer cooperators.

7. *Seed Education.* One way to improve and expand the production of certified seed by farmer cooperators is to train the personnel of the Bureaus of Plant Industry and Agricultural Extension assigned to the Certified Seed Program. The College of Agriculture has taken a leading role in the educational phase of the Certified Seed Program through participation in seed schools. The first seed school designed by the College of Agriculture and by the staff of the Bureau of Plant Industry and the Bureau of Agricultural Extension was held at the College of Agriculture from September 10-12, 1956. Seven seed schools in which farmer cooperators also attended were conducted in six different rice regions of the Philippines. The curriculum included all aspects of rice production, screening of cooperators, and all the phases of field inspection and certification of the crop. A seed certification handbook was printed. This handbook describes the history and organization of the Cooperative Rice and Corn Improvement Program, outlines the specific requirements followed in the production of certified seed and contains copies of various forms used by the field inspectors and certified seed growers.

PRODUCTION OF CERTIFIED SEED

The Certified Seed Program

The production of certified seed which is the most important phase of the Cooperative Rice Improvement Program is not progressing as it should. In the Bureau of Plant Industry stations only 50 per cent of the samples of the registered seed produced were approved. The main causes of disapproval were presence of excessive amount of red rice and mixtures of other varieties.

The amount of certified seed of upland and lowland rice for 1956-57 was less than what was expected. The main cause was that most certified seed cooperators did not bother to have samples sent to the Seed Laboratory because the certified seed crop was purchased by other farmers immediately after harvest. This practice should

be discouraged because the certified seed program requires that seed sold must bear the seed certification tag. If this practice will continue, poor quality seeds will be sold to farmers. These farmers later on may lose their confidence in the Cooperative Program. The supervision given to farmer cooperators in the production of certified seed is very inadequate because the extension personnel assigned to the certified seed program has 14 other farm projects of the government to attend to. To remedy the unhealthy situation of the certified seed program, this plan below as agreed upon by the three cooperating organizations is being implemented:

I. *Increase the efficiency of certified seed cooperators in the production of certified seeds.*

1. Better choice of farmer cooperators; only those cooperators whose crops were certified the previous year will be recommended.

2. Reduce the number of cooperators in a province to 3 or 4; only cooperators with at least 10 hectares of lowland rice or 4 hectares of upland rice will be approved.

3. Better supervision of cooperators and more inspections of fields of certified seed crop by:

(a) Appointment of 16 Bureau of Agricultural Extension personnel as certified seed supervisors. Their functions and duties are:

1. Select farmer-cooperators for growing certified seeds.
2. Allocate registered seeds needed for each province annually.
3. Help prospective cooperators obtain seeds for planting.
4. Teach farmers the different steps in the production of certified seeds.
5. Inspect the fields of cooperators and advise farmers in modern cultural practices such as better preparation of land, thorough weeding, fertilization, control of pests and disease, etc.
6. Assist in obtaining and submitting samples for certification.
7. Assist in tagging and sealing of bags.
8. Help the farmer-cooperators market their certified rice seed.

9. Help prospective buyers locate sources of certified seeds.

(b) Appointment of 16 Bureau of Plant Industry personnel as certified seed inspectors. Their functions and duties are:

1. Screen cooperators selected by the BAE.
2. Follow up distribution of registered seeds.
3. Help the municipal agriculturists in securing planting materials.
4. Examine the seeds of rice and corn, etc., for pests and diseases and for proper treatment of such seeds.
5. Assist in the production procedure.
6. Make preliminary inspection when crop is in bloom and advise farmers to rogue and make final inspection before harvest for certification.
7. Submit inspection and field certification reports.
8. Sample and submit samples for certification.
9. Tag and seal rice bags.
10. Cooperate with the provincial agriculturists.

2. *Increase efficiency in the production of registered seed at BPI stations by closer supervision in the production of registered seed and frequent inspection of this by technical personnel.*

3. *Establish a seed laboratory in Maligaya and in Iloilo City.*

Farmers complain about the length of time before seed samples can be analyzed. Director Cruz claims that BPI already has the necessary equipment for these two laboratories.

All the BPI personnel (Certified Seed Inspectors) and BAE personnel (Certified Seed Supervisors) were trained in the College and in the BPI Seed Laboratory for one month. To each of the 16 major rice producing provinces, one Certified Seed Supervisor and one Certified Seed Inspector have been assigned and these two personnel are committed to work full-time on the production of certified seed in their respective provinces.

An organization chart of the Seed Certification Program was drawn by the three cooperating organizations (fig. 1). This set-up tends to do away with the red-tapes or delays involved in the production of certified seed.

If plans as drawn will be religiously implemented, there is no doubt that the Philippines will be self-sufficient in certified seed by 1960.

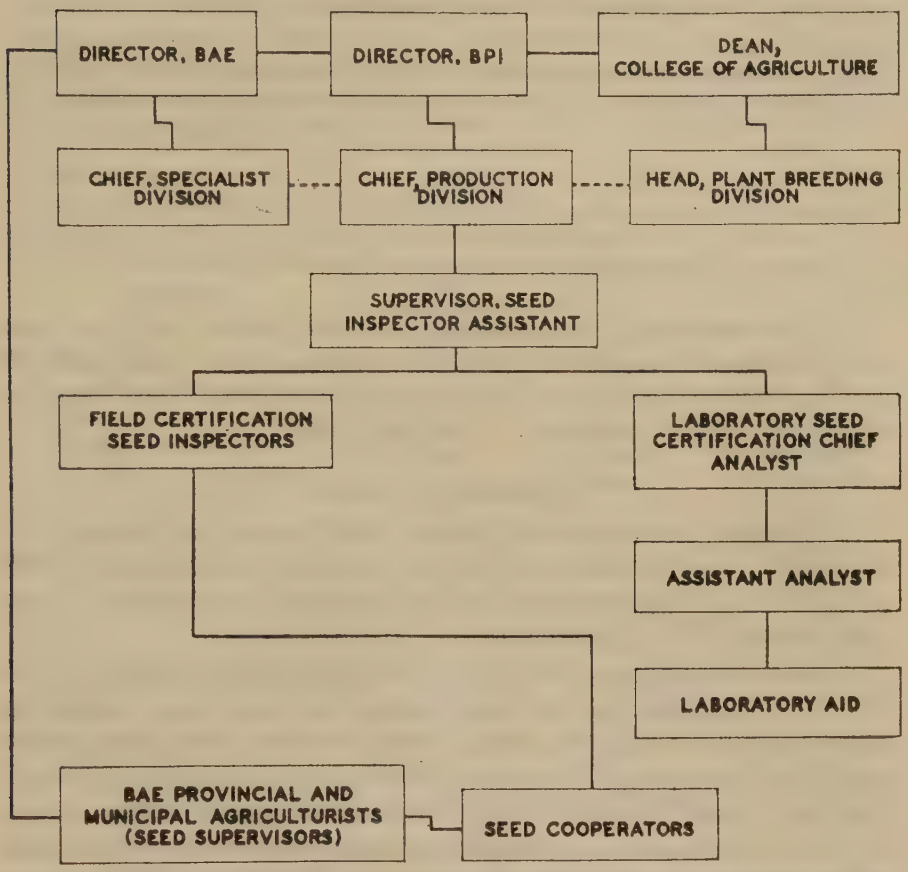

Fig. 1.—Organization Chart of the Seed Certification Program

EFFECTS OF REPEATED HERBICIDE SPRAYING ON UPLAND RICE [1]

J. R. Velasco, M. R. Vega and P. A. Llena

Results indicate that rice plants of the Azucena variety can stand repeated spraying of Kuron (2,4,5-trichlorophenoxypropionic acid) very well. A total of 3.7 pounds per acre did not significantly reduce grain yield.

Apparently, as far as weed control is concerned, spraying twice is just as good as spraying three or five times. The two sprayings must however be spaced about 30 to 45 days apart, with the last spraying so timed that plants are ready to close in after its application.

This experiment was conducted to find out if the rice plant can withstand repeated herbicide spraying. The work aims to provide information on how many and when to make these repeated sprayings without detriment to the rice plants.

MATERIALS AND METHODS

Azucena, an upland rice variety, was planted in plots on July 29, 1957. The rice was seeded at the rate of 25 grams per 11-meter rows which is equivalent to about 25 gantas to a hectare. Each plot measured 2 × 11 meters.

Since the primary interest was to find out the effect of repeated herbicide spraying on the rice plants, all plots were cleaned of weeds that survived the spray. Weed counts were taken before weeding the plots. Other observations taken included growth in height of the plants, number of tillers and yield of grains.

The experiment was conducted in an upland rice field of the U.P. College of Agriculture and Central Experiment Station from July to November, 1957.

RESULTS AND DISCUSSION

Effect on rice plants

Growth in height. The heights of the rice plants were taken at 45, 60 and 75 days after planting. When the herbicide was ap-

[1] Central Experiment Station Contribution No. 1958. Part of Project 528 financed by a grant from the NARIC.

plied only once its stunting effect on the height of the rice plants disappeared in about a month. When applied repeatedly stunting was correspondingly prolonged. Although the plots were hand-weeded twice, apparently the weeds caused stunting of the rice plants. At the last measurement made 75 days after planting, all chemically treated plants were taller than the untreated plants. However, only those that received a single dose, except when applied 20 days after planting, significantly increased the height of the rice plants over the control (table 1).

TABLE 1.—*Effect of repeated spraying of Kuron (¾ pound per acre) on the height of rice plants (cm.)*

TREATMENT	DAYS AFTER PLANTING AT MEASUREMENT		
	45	60	75
I Control	47.15 [b]	82.42	93.45
II 10 [a]		81.59	110.50
III 15	49.68	92.06	110.20
IV 20	45.43	85.16	104.00
V 30	51.35	88.41	109.00
VI 15, 30, 45, 60, 75	47.47	80.84	103.80
VII 15, 45, 75	47.94	79.29	101.15
VIII 15, 30	44.86	80.82	102.00
IX 15, 45	43.77	75.17	98.80
X 15, 60	44.53	82.64	96.20

SMD at 5% = 10.88

[a] Number of days after planting at treatment.
[b] Averages of 4 replications, 5 observations per replicate.

Number of tillers. The tillers of the plants were counted only once, at 75 days after planting (table 2). None of the treatments significantly increased or reduced the number of tillers per plant over the control. The slight increase in the number of tillers was observed in plants treated with the herbicide once at 10, 15 and 30 days after planting and when treated repeatedly at 15, 30, 45, 60 and 75 days and 15 and 60 days after planting. This observation with regard to the increase in the number of tillers in these treatments is at variance with previous observations which showed that 2,4-D and 2,4-D related herbicides inhibit tiller production. Where herbicide was applied only once it was likely that the plants still had a chance to catch up in tiller production after the effect of the herbicide was gone. Where the herbicide was applied as many as five times this observation seems odd. Our previous and present observations could probably be reconciled by noting that the experi-

ments where we observed this inhibition of tiller formation were done in pots where a single plant was maintained or in plots under lowland conditions where plants had room to develop tillers. In the present experiment the rice plant which was drilled did not leave much room for tiller formation. In this case, then differences in the number of tillers between the treatments is unlikely to occur. Verification of this contention is highly desirable.

TABLE 2.—*Effect of repeated spraying of Kuron (¾ pound per acre) at intervals on the number of tillers at 75 days after planting*

TREATMENT	REPLICATION				TOTAL	AVERAGE
	1	2	3	4		
I Control	3.0 [a]	3.2	2.0	1.6	9.8	2.45
II 10	3.0	3.4	2.4	2.2	11.0	2.75
III 15	2.8	2.6	3.0	3.0	11.4	2.85
IV 20	2.0	2.6	3.0	1.8	8.4	2.35
V 30	2.8	3.0	2.4	3.2	11.4	2.85
VI 15, 30, 45, 60, 75	2.2	3.8	2.6	2.4	11.0	2.75
VII 15, 45, 75	2.4	2.0	2.8	2.6	9.8	2.45
VIII 15, 30	2.6	2.2	2.4	2.2	9.4	2.35
IX 15, 45	2.4	1.8	3.2	1.8	9.2	2.30
X 15, 60	2.6	2.2	3.2	2.0	10.0	2.50

[a] Averages of five observations per replicate.

Grain yield. Because the rice plants were planted rather late in the season, they were still in the field when the rest were already harvested. Thus portions of the plots that were unprotected by cages were rather heavily damaged by birds. The yield was thus based on those harvested from these enclosed areas (1.6 meters per plot). Based on the yield obtained from these protected areas none of the treatments significantly reduced or increased grain yield (table 3). The following treatments arranged in a descending order, had higher yields than the control: treatments VIII (at 15 and 30); X (at 15 and 60) and IX (at 15 and 45). In treatment no. VI, a total of 3.7 pounds of Kuron per acre was applied; the fact that the yield of grain was not significantly reduced compared to the control shows, relatively speaking, how resistant this variety of rice is to this type of herbicide. The same observation was recorded in a previous experiment where 3 pounds of 2,4-D per acre was used.

Effect on weeds

The weed species present were: *Echinochloa colonum* (L.) Link., *Eleusine indica* (L.) Gaertn., *Digitaria sanguinalis* (L.) Scop., *Cy-*

perus rotundus L., *Amaranthus spinosus* L., *Commelina benghalensis* L., *Celosia argentea* L., *Ipomoea triloba* L., and *Portulaca oleracea* L.

TABLE 3.—*Effect of repeated spraying of Kuron (¾ pound per acre) on the yield of grains (grams per 1.6 square meters)*

TREATMENT	REPLICATION			TOTAL	AVERAGE
	1	2	3		
I Control	110.20	135.63	109.26	355.09	118.36
II 10	114.50	111.14	124.33	349.97	116.66
III 15	116.79	117.07	91.36	325.22	108.40
IV 20	142.22	103.60	72.52	318.34	106.11
V 30	95.13	116.79	71.58	283.50	94.50
VI 15, 30, 45, 60, 75	66.87	91.36	120.56	278.79	92.93
VII 15, 45, 75	123.38	113.97	97.01	334.36	111.45
VIII 15, 30	110.20	162.00	129.98	402.18	134.06
IX 15, 45	137.51	126.21	131.86	395.58	131.86
X 15, 60	143.16	133.74	123.38	400.28	133.43

Differences insignificant.

a. *Man-minutes to handweed each plot.* Since the plots were wheel-hoed and handweeded twice, the number of man-minutes to handweed each plot is a good indication of the effect of the different treatments on the different weed species. Assuming all other things to be equal in the plots, a longer time required to handweed a plot means a less effective treatment. At 38 days after planting, it took 50 minutes to handweed the untreated plots. Excluding observations from treatments VIII and IX, spraying at 20 days after planting did not seem to reduce weeding time too much. However, reduction in weeding time was doubled that at 20 days when spraying was made 30, or 15, 30, 45, 60 and 75 days after planting (table 4). In the second handweeding made 52 days after planting the number of man-minutes to handweed the plots was greatly reduced in those plots that were treated 45 days after planting. To a less extent, the other treatments also reduced the time to handweed each plot (table 5). The rice plants were observed to have closed in in about 45 to 50 days after planting. Thus after handweeding at 52 days weed counts were made at ten-day intervals for thirty days after weeding to find out the amount of regrowth that took place in the different treatments. It must be pointed out again that it was mostly *Cyperus rotundus* L. that came out after this last weeding. The number of weeds was in all cases lower in the treated plots than in the control. At the last counting, the least number of weeds was observed in treatment number VII (table 6). This

probably was due to the almost continuous presence of herbicide possibly in the soil (especially true in treatments where repeated sprayings were made) and/or due to a better shading of the ground afforded by the chemically treated plants. It will be noted later that the chemically treated plants were taller than the untreated plants.

b. *Number of weeds.* At any one weed counting date, except that one made 14 days after planting at which time most of the treatments had not been made, there were fewer weeds in the treated plots than in the control (tables 7 and 8). For example, at 75 days after planting there were 10.99 weeds per 625 square centimeters in the untreated plots whereas the number of weeds in the treated plots ranged from 3.68 to 7.87.

TABLE 4.—*Man-minutes to handweed each plot 38 days after planting*

TREATMENT	REPLICATION		TOTAL	AVERAGE
	3	4		
I Control	35	65	100	50.0
II 10	55	40	95	47.5
III 15	40	45	85	42.5
IV 20	40	40	80	40.0
V 30	28	33	61	30.5
VI 15, 30, 45, 60, 75	25	40	65	32.5
VII 15, 45, 75	65	35	100	50.0
VIII 15, 30	40	70	110	55.0
IX 15, 45	65	60	125	62.5
X 15, 60	40	—	40	40.0

TABLE 5.—*Man-minutes to handweed each plot 52 days after planting*

TREATMENT	REPLICATION				TOTAL	AVERAGE
	1	2	3	4		
I Control	26	46	45	55	172	43.00
II at 10	26	12	26	31	95	23.75
III at 15	16	12	45	40	85	21.25
IV at 20	22	12	40	48	122	30.50
V at 30	14	16	15	45	90	22.50
VI at 15, 30, 45, 60, 75	14	10	30	27	81	20.25
VII at 15, 45, 75	14	14	25	26	79	19.75
VIII at 15, 30	18	16	48	40	122	30.50
IX at 15, 45	12	12	15	35	74	18.50
X at 15, 60	14	22	46	33	115	28.75

TABLE 6.—*Summary table on weed population increment after weeding at 52 days after planting*

TREATMENT	DAY AFTER WEEDING AT WEED COUNTS		
	10	20	30
I Control	6.81 [a]	10.99	9.87
II 10	3.75	5.68	6.30
III 15	5.43	7.87	7.55
IV 20	5.06	7.17	7.68
V 30	4.31	6.98	7.59
VI 15, 30, 45, 60, 75	2.31	4.05	3.74
VII 15, 45, 75	2.12	3.68	4.12
VIII 15, 30	4.56	7.06	7.05
IX 15, 45	2.50	4.43	5.18
X 15, 60	4.06	4.68	4.74

[a] Refers to number of weeds per 625 sq. cm.

TABLE 7.—*Effect of repeated spraying of Kuron (¾ pound per acre) at intervals on the number of weeds per 625 square centimeters*

TREATMENT	NUMBER OF DAYS AFTER PLANTING AT OBSERVATION			
	14	52	63	74
I Control	27.63	13.81	6.81	10.99
II 10	14.94	8.00	3.75	5.68
III 15	41.31	12.36	5.43	7.87
IV 20	34.44	13.44	5.06	7.17
V 30	31.13	6.81	4.31	6.98
VI 15, 30, 45, 60, 75	39.63	6.81	2.31	4.05
VII 15, 45, 75	50.19	6.81	2.12	3.68
VIII 15, 30	52.63	9.06	4.56	7.06
IX 15, 45	45.38	8.19	2.50	4.43
X 15, 60	35.44	9.60	4.06	4.68

Of the weed species mentioned, the first four are monocots and the rest are dicots (broadleaved weeds). The latter group is supposedly susceptible to the spray while the former group, except *Cyperus rotundus* L., is relatively resistant to 2,4-D and 2,4-D related herbicides. As a reflection of these relative susceptibilities between the two groups, it will be noted in treatment number 2 which was sprayed 10 days after planting that there was a change in the relative abundance of the two groups. After applying the treatment, the grass weeds became greater in number compared to the dicots. This situation was true up to 52 days after planting. In the observations made 63 and 74 days after planting the broadleaved weeds became greater in number compared to the grasses due to the crop-

TABLE 8.—*Composition of weeds at each weed count*

TREATMENT	NUMBER OF DAYS AFTER PLANTING AT OBSERVATION							
	14		52		63		74	
	% of total		% of total		% of total		% of total	
	B	G	B	G	B	G	B	G
I Control	36.47	63.53	53.14	46.86	85.22	14.70	89.27	10.73
II 10	24.15	75.85	35.95	64.05	65.00	35.00	68.14	31.86
III 15	45.67	54.33	63.67	36.33	74.60	25.40	80.93	19.05
IV 20	40.53	59.47	77.14	22.86	80.30	19.70	80.90	19.10
V 30	40.46	59.54	62.28	37.72	79.60	20.40	83.96	16.04
VI 15, 30, 45, 60, 75	34.97	65.03	50.63	49.37	94.80	5.20	97.04	2.96
VII 15, 45, 75	42.81	57.19	44.93	55.07	73.90	26.10	71.20	28.80
VIII 15, 30	5.35	49.65	50.44	49.56	65.90	34.10	68.14	31.86
IX 15, 45	51.92	48.08	51.04	48.96	80.00	20.0	93.01	6.99
X 15, 60	40.17	59.83	68.23	31.77	56.90	43.10	61.33	38.69

B = Broadleaved weeds (dicots).
G = Graminaceous weeds (monocots).

ping up of *Cyperus rotundus* L. Apparently *Cyperus rotundus* L. can germinate even under shaded conditions as the rice plants were observed to have closed in at about 45 to 50 days after planting.

Apparently, delaying the spray application to about 15 days after planting or even up to 30 days after planting allows the dicots to acquire some resistance to Kuron and better competing power with grasses. In treatments III, IV and V (sprayed 15, 20 and 30 days after planting, respectively), the dicots were always greater in number except for the observation at 14 days after planting.

Based on the last weed count taken at 74 days after planting, repeated spraying of ¾ pound per acre of Kuron reduced weed population to a greater extent than the single applications (treatments VI, VII, IX and X; table 7). The exception to this was treatment VIII which was sprayed 15 and 30 days after planting. It is apparent that more weeds had still enough time to come out when the last spraying was as early as 30 days after planting. Based on the number of weeds at 74 days after planting, the effect of spraying at 30 and at 15 and 30 days after planting is about the same, the weed population being 6.98 and 7.06 weeds per 625 square centimeters in the two treatments, respectively. It is apparent that spacing the two sprayings too close to each other (about 15 days apart) is not advantageous. Spacing the two sprayings about 30 to 45 days apart proved more advantageous (treatments I, IX and X). The difference between the number of weeds in plots sprayed three or

five times and those sprayed only twice was not much. In treatments IX and X the values were 4.43 and 4.68 and in VI and VII the values were .05 and 3.68 weeds per 625 square centimeters, respectively.

* * *

Friendly competition as well as cooperation is a stimulus to achievement in science as in other forms of human endeavor. Because scientists are human, they naturally wish to be first to achieve success in a scientific undertaking. But all scientists are fellow explorers on the frontier of knowledge, who rejoice and benefit in the discoveries and achievements of their colleagues.

—D. W. Bronk

PLANTING DATES OF CORN IN RELATION TO INSECT INFESTATION [1]

G. B. Viado, A. F. Banaag, and R. A. Luis

Two rainy season tests were conducted to find the relation of planting dates of corn to insect infestation. Of the six species of insects affecting corn plants, the borer and the earworm were the most destructive.

The second planting in the 1956 test had the most borer and earworm injuries from the early generation of these species. In the 1957 test, the third planting was the most infested by borers and the fourth, by earworms. Subsequent plantings after the peak of infestation suffered very little injury.

In both tests the first planting gave the highest yield. There was abrupt decrease in yield as planting date was delayed.

In the 1957 test, there were considerable and consistent decreases in percentage germination and height of plants as planting was delayed. There was rapid increase in downy mildew incidence in the second to the fourth planting and a subsidence thereafter.

Besides insect injury, other factors like low percentage germination, high incidence of downy mildew infection, and poor stand of the plants were responsible for rapid decrease in yield as planting was delayed.

Farmers believe that corn planted early in the season gives higher yield than that planted late. They attribute this to unfavorable climatic condition and heavy insect damage a few weeks after the start of the rainy season. While unfavorable rainfall and insect attacks affect normal development of corn plants, it is not known to what extent these factors contribute to the losses.

Maximum injury is brought about by the coincidence of the stage of the crop when it is most susceptible to infestation with the time when most of the adults of its insect pests appear. Very often, emergence of most of the adults in a given generation does not coincide with the availability of the host at the right stage for infestation.

To determine the effects of planting at different dates on insect infestation and yield, two tests were conducted at the Central Experiment Station from April to October, 1956 and from June to November, 1957.

[1] Central Experiment Station Contribution No. 1959.

MATERIALS AND METHODS

In the 1956 test, five randomized blocks, each consisting of six dates of planting were used. The dates of planting were: May 26, June 11, June 26, July 11, July 26, and August 6. Each plot measured 8 by 18.5 meters, consisting of 11 rows with 23 hills per row. Data were taken from nine rows, leaving two border rows. The variety used was Cuban Yellow Flint. Six seeds were planted to a hill but the plants were thinned to three to a hill after a month. Agronomic practices in connection with the commercial production of corn were followed. Infestation counts were made when the plants were one, two, and three months old. All insects affecting the plants throughout the test were noted.

The second test was conducted in the rainy season of 1957. The experimental design, care of the plants and data taken were the same as those in the first test. The size of each plot was 8 by 15 meters and contained 10 rows with 20 hills per row. Data were taken from the middle eight rows. The dates of planting in this test were: June 6, June 21, July 6, July 21, August 6, and August 21. Aside from data on insect infestation, percentage germination, incidence of downy mildew infection, and height of plants were taken in each planting.

Insect infestation was reckoned in percentage of the plant population in each treatment injured by the insect.

RESULTS AND DISCUSSION

The last planting in the first test was a complete failure due to frequent heavy rains. Very few seeds germinated and ensuing plants were badly attacked by downy mildew. The few plants that were able to reach maturity were stunted and did not produce ears.

Borer. In the first test, the second planting contained the highest percentage of stalks damaged by corn borer (*Pyrausta salentialis* Snellen) in both the two- and three-month-old plants (table 1a). The order of the planting dates containing the highest to the lowest infestation at three months old were: June 11, May 26, July 11, June 26, and July 26. The number of borer holes per 10 stalks at this age almost follow the same order. The order of the planting in this category based at three months old was: June 11, May 26, June 26, July 11, and July 26. In the second test, those planted on July 6

contained the highest percentage of stalks damaged by borer at the age of two and three months (table 1b). The order of the plantings based on the percentages of stalks damaged by borer, from the highest to the lowest, were the same at two and three months, namely: July 6, July 21, June 21, August 6, August 21, and June 6. The highest number of holes per ten stalks at both two and three months old were found in the plants planted July 21. The order on the basis of number of holes per 10 stalks from the highest to the lowest was the same for both ages, namely: July 21, July 6, June 21, August 6, August 21, and June 6.

TABLE 1a.—*Borer damage on the stalk at different ages of the plants (Rainy season, 1956)*

DATE OF PLANTING	PER CENT STALKS WITH HOLES				NUMBER OF HOLES PER TEN STALKS	
	2 months		3 months		2 months	3 months
	Actual	Angle	Actual	Angle	Actual	Actual
May 26	2.76	9.16	49.54	44.75	0.44	17.79
June 11	51.48	45.85	90.71	73.65	21.00	26.43
June 26	8.41	15.27	21.86	75.73	1.35	6.35
July 11	2.49	8.92	22.34	27.50	0.12	3.53
July 26	2.44	7.40	3.32	10.20	0.28	0.47
S.M.D. (T) 5%		23.35		14.85	5.58	6.02
1%		38.72		24.63	9.25	9.99

TABLE 1b.—*Borer damage on the stalk at different ages of the plants (Rainy season, 1957)*

DATE OF PLANTING	PER CENT STALKS WITH HOLES				NUMBER OF HOLES PER TEN STALKS	
	2 months		3 months		2 months	3 months
	Actual	Angle	Actual	Angle	Actual	Actual
June 6	0	0	1.33	5.69	0	0.19
June 21	7.32	15.04	12.86	20.97	1.35	1.89
July 6	49.00	44.40	65.46	54.17	2.09	10.28
July 21	7.32	15.04	12.86	20.97	1.35	1.89
August 6	5.28	9.87	7.82	15.88	0.58	1.18
August 21	0.86	4.56	1.60	6.14	0.12	0.32
S.M.D. (T) 5%		9.45		7.59	1.99	5.96
1%		13.07		10.50	[a]	8.24

[a] Insignificant.

The order on the basis of number of borer holes per 10 stalks more or less follows that on the basis of infested stalk. Patch (1939) reported that there are more borers per infested plant when a larger percentage of plants is infested than when a smaller percentage is infested and that the relationship between the two is linear.

In his study on the pattern of infestation of *P. nubilalis* Hubn. in relation to growth stages of corn in Connecticut, Beard (1943) found that the initial planting was most severely attacked by the first generation and that subsequent plantings were less attacked. In the present study, emergence of most of the adults giving rise to the early generation of the borer coincided with the second planting, which received most of the injury from that generation. With regard to the height of plants most susceptible to borer attack, Patch *et al.* (1942) observed that the plots of tall corn always contained more eggs than plots of short corn.

Both tests showed a large number of ears attacked by borers. Batchelder (1949) reported that the larva enters the plant successfully through the interfoliar spaces, immature tassels, tassel florets, ear shoot, leafsheath, and ears, and that the extent to which these locations are utilized depends upon the maturity of the plants.

Earworm. In the first test, at one month old only the plants in the first two plantings (June 11 and May 26) showed considerable infestation of the whorl by *Heliothis armigera* Hubn. (table 2a). The infestation in the other plantings were either very low or totally absent. In the absence of young ears the larva feeds on the whorl or on any tender portion of the growing plant. This explains the habit of the moth of laying her eggs on any part of the plant and at any time as long as the plant is still green (Barber, 1943). Orlando (1942) observed that most of the eggs of *Heliothis* are laid on the silk, particularly young green silk. The injury to the ears at the time of the last count, however, was considerable in all the plantings. The highest percentage of infested plants (43.08) was in the second plant-plantings. Infestation in the third planting (1.22) was very low compared with the other plantings. In the second test, which was conducted from June to November, 1957, all plantings were badly ing, followed by the first (27.96), fifth (15.61) and fourth (14.03) infested at all ages (table 2b). The fourth planting (July 21) had the heaviest infestation of earworm on both leaves and ears. Injury to the ears at the time of harvest in this planting was 65.30 per cent, followed by 29.24 per cent in the second planting,

27.71 in the first, 26.31 in the third, 19.68 in the fifth and 18.76 in the sixth.

TABLE 2a.—*Monthly record of infestation by Aphis and Cyllo in mean percentages and their transformed angles (Rainy season, 1956)*

DATE OF PLANTING	HELIOTHIS						PLUSIA			
	1 month		2 months		3 months		1 month		2 months	
	Actual	Angle	Actual	Angle	Actual	Angle	Actual	Angle	Actual	Angle
May 26	23.59	28.96	26.33	30.73	27.96	31.87	19.90	26.08	9.65	18.08
June 11	36.33	36.40	43.08	40.69	43.08	40.69	21.59	27.56	5.36	12.54
June 26	0.59	2.99	1.22	5.28	1.22	5.28	11.22	16.81	0.56	17.52
July 11	0	0	7.35	15.21	14.03	21.67	6.42	14.38	0	0
July 26	0.29	2.19	7.14	15.10	15.61	22.92	14.32	21.04	0.16	3.54
S.M.D. (T) 5%	12.51		15.27		15.21		[a]		11.54	
1%	20.75		25.32		25.23		[a]		19.14	

[a] Insignificant.

TABLE 2b.—*Monthly record of infestation by Aphis and Cyllo in mean percentages and their transformed angles (Rainy season, 1957)*

DATE OF PLANTING	HELIOTHIS						PLUSIA			
	1 month		2 months		3 months		1 month		2 months	
	Actual	Angle	Actual	Angle	Actual	Angle	Actual	Angle	Actual	Angle
June 6	1.73	6.73	25.17	29.69	27.71	31.39	6.77	14.07	5.64	13.12
June 21	2.64	8.02	27.70	31.18	29.24	32.30	32.67	34.83	2.00	7.62
July 6	6.92	14.64	23.55	28.72	26.31	30.60	64.16	53.43	2.68	9.27
July 21	34.00	34.97	62.08	52.16	65.30	54.80	8.38	16.40	1.11	4.91
Aug. 6	12.27	20.33	16.31	23.66	19.68	26.21	14.01	21.66	1.43	5.68
Aug. 21	16.59	23.89	17.02	24.20	18.76	25.54	3.26	9.00	1.88	5.49
S.M.D. (T) 5%	9.70		9.47		9.06		9.23		[a]	
1%	13.42		13.10		12.54		12.77		[a]	

[a] Insignificant.

Other insects. Infestation by the semi-looper, *Plusia chalcytes* Esper, was high in both tests. There was lighter infestation in the first test than in the second test. In the first test, the second planting showed the heaviest infestation, 21.59 per cent, followed by the first, fifth, third, and fourth (table 2a). The heaviest infestation in the second test was in the third planting, 64.16 per cent (table 2b). This was followed by the second, fifth, fourth, first, and sixth plantings.

Aphid infestation on the different planting dates in both tests was more evident when the plants were two months old than when they were a month old. The heaviest infestation in both tests was in the first planting. Infestation in subsequent plantings was almost negligible.

In the first test the heaviest infestation by *Cyllo leda* Cramer was in the second planting when 17.34 per cent of the one-month-old plants were infested (table 3a). This was followed by the third, fourth, fifth, and first plantings. There were infestations in all plantings in the second test (table 3b). Infestation increased as date of planting was delayed.

TABLE 3a.—*Monthly record of infestation by Aphis and Cyllo in mean percentages and their transformed angles (Rainy season, 1956)*

DATE OF PLANTING	APHIS						CYLLO			
	1 month		2 months		3 months		1 month		2 months	
	Actual	Angle	Actual	Angle	Actual	Angle	Actual	Angle	Actual	Angle
May 26	0	0	31.95	34.40	0.07	0.79	0	0	1.62	7.09
June 11	0	0	0.25	1.44	0	0	17.34	23.36	9.52	17.88
June 26	0	0	2.24	7.55	0	0	3.70	5.66	1.56	5.05
July 11	4.50	11.76	4.50	11.76	0	0	1.56	5.99	0	0
July 26	0.10	0.91	0	0	0	0	0.99	6.53	3.42	8.42
S.M.D. (T) 5%	a		6.91		a			15.06		10.05
1%	a		11.46		a			a		16.68

[a] Insignificant.

TABLE 3b.—*Monthly record of infestation by Aphis and Cyllo in mean percentages and their transformed angles (Rainy season, 1957)*

DATE OF PLANTING	APHIS						CYLLO					
	1 month		2 months		3 months		1 month		2 months		3 months	
	Actual	Angle	Actual	Angle	Actual	Angle	Actual	Angle	Actual	Angle	Actual	Angle
June 6	0	0	12.31	19.09	1.87	6.12	0.76	4.75	2.80	7.72	0	0
June 21	0	0	0.84	4.24	0	0	0.96	5.19	2.92	9.81	0	0
July 6	0.83	3.64	0.80	4.27	0	0	3.61	10.80	2.55	7.76	0	0
July 21	0.56	2.88	0	0	0	0	3.60	10.69	4.50	17.89	0.74	2.45
Aug. 6	0	0	0.22	1.36	0	0	6.67	14.18	3.56	9.83	1.04	2.96
Aug. 21	0	0	0.74	3.51	0	0	10.75	18.61	6.98	14.43	1.42	3.45
S.M.D. (T) 5%	a		7.11		a			5.85		a		a
1%	a		9.83		a			8.09		a		a

[a] Insignificant.

Slight infestation by *Monolepta* in two plantings in the first test appeared when the plants were one month old. At two months, three of the five plantings were infested. Those planted on July 11, 1957 did not show infestation at the age of one month but at two months; the silks of 25.76 per cent of the plants were damaged by *Monolepta*. Two other plantings which were infested each had the silk of only less than one per cent of the plants infested. No infestation by this insect was noted in the second test.

Of the six species of insects affecting corn recorded in this study, only two were of major importance as pests, the stem borer and the earworm. *Monolepta* at times became a serious pest but in the present investigation, it was not present in large numbers in either of the two tests. *Plusia, Cyllo,* and *Aphis* although abundant at times were not known to attain such serious proportions on corn.

Effects of the planting dates on germination, number of plants infected with downy mildew, and height of plants were taken in the second test. There was considerable and consistent decrease in percentage germination and height of plants as planting was delayed (table 4). The differences between percentages of germination and between height of plants in the differnt dates of planting were significant. There was rapid increase in downy mildew incidence as planting was delayed. This increase, however, was noted only up to the fourth planting, after which the incidence dropped considerably. The difference in percentages of infection between dates of planting was likewise significant.

TABLE 4.—*Mean percentages of germination and plants infected with downy mildew and mean height of plants in centimeters (Rainy season, 1957)*

DATE OF PLANTING	GERMINATION		INFECTED WITH DOWNY MILDEW		HEIGHT OF PLANTS
	Actual	Angle	Actual	Angle	Actual
June 6	84.42	67.75	1.19	5.15	232.38
June 21	76.19	60.94	1.39	6.29	195.93
July 6	68.93	56.26	20.49	24.86	152.30
July 21	48.46	44.11	52.68	46.58	130.00
August 6	24.83	29.82	13.59	21.12	128.80
August 21	23.54	28.92	13.61	21.22	125.97
S.M.D. (T) 5%		7.73		12.73	16.14
1%		10.69		17.61	22.32

1956 test. Results of this test showed abrupt decrease in yield as planting was delayed. The first planting gave the highest yield with a mean of 45.46 kilograms of kernel per plot or 69.32 cavans per hectare, followed by 32.50 cavans in the second planting, 3.40 in the fifth, 2.10 in the third, and 1.19 in the fourth (table 5a).

TABLE 5a.—*Mean yield in kilograms of dry kernels containing 14 per cent moisture and yield in cavans per hectare*
(Rainy season, 1956)

DATE OF PLANTING	REPLICATION				TOTAL	MEAN	YIELD IN CAVANS PER HECTARE
	I	II	III	IV			
May 26	40.45	54.82	43.82	42.77	181.86	45.46	69.32
June 11	34.59	13.32	4.18	33.73	85.82	21.46	32.50
June 26	0.23	0.36	0.91	4.04	5.54	1.38	2.10
July 11	0.73	1.27	0.43	0.69	3.12	0.78	1.19
July 26	1.32	1.32	3.00	3.27	8.91	2.23	3.40
Total	77.32	71.09	52.34	84.50	285.25		

S.M.D. (T) 5% = 11.85
1% = 16.61

The second planting (June 11) received the brunt of infestation by the early generation of borers, earworms, *Plusia,* and *Cyllo.* Infestation by these insects in the first planting (May 26) although considerable was much lower than that in the second. In subsequent plantings, although infestations dropped abruptly, the corresponding yield also dropped. This drop in yield may have been the combined effects of several conditions unfavorable to the germination, growth, and development of the plants.

Rainfall increased almost steadily from April (3.93 inches) to September (13.75 inches), 1956, the period covering the planting dates in the first test and from May (1.02 inches) to October (15.72 inches) 1957, the period covering the planting dates in the second test. It is quite possible that the high rainfall at the height of infestation contributed immensely to the borer injury on the plants.

In his study on the effect of humidity on the development of the corn borer, Kozhanchikov (1937) reported that under optimum temperature conditions, eggs were able to develop only at a relative humidity of 70 to 100 per cent and that high fertility and normal longevity of the adults occurred only at 100 per cent humidity. In spite of the heavy borer injury in those periods of high rainfall in

the present study, the yield was high, compared with other plantings where borer infestation was low. Coaker (1956) reported that the importance of a given amount of borer damage in affecting cropping will depend on environmental conditions, particularly water availability and soil fertility. Low rainfall and soil fertility may accentuate the effects of borer injury to the plants.

1957 test. In the second test, the yield also decreased as planting was delayed. The sequence in terms of yield in cavans per hectare was: 48.75 in the first planting, 17.56 in the second, 13.64 in the third, 2.76 in the fourth, 0.15 in the fifth, and 0.09 in the sixth (table 5b).

TABLE 5b.—*Mean yield in kilograms of husked ears and yield in cavans of shelled corn per hectare*
(Rainy season, 1957)

DATE OF PLANTING	REPLICATION				TOTAL	MEAN	YIELD IN CAVANS OF SHELLED CORN PER HECTARE
	I	II	III	IV			
June 6	34.45	27.55	31.36	35.36	128.72	32.18	48.75
June 21	8.09	7.77	11.64	18.86	46.36	11.59	17.56
July 6	10.77	11.14	4.05	10.05	36.01	9.00	13.64
July 21	2.68	1.41	2.18	1.05	7.32	1.83	2.76
August 6	0	0.29	0.10	0	0.39	0.10	0.15
August 21	0	0	0.18	0.05	0.23	0.06	0.09
Total	55.99	48.16	49.51	65.37	219.03		

S.M.D. (T) 5% = 4.28
1% = 5.92

The height of infestation by the early generation of borers and *Plusia* was observed in the third planting, July 6. The heaviest infestation by the earworms, however, was observed in the fourth planting, July 21. The highest population count of the adult borers in the early generation came two weeks ahead of the earworms, so that all the plantings prior to July 21 escaped heavy damage by earworms. Subsequent infestation, however, dropped abruptly. In their study of the factors determining reduction in yield of field corn by the European corn borer, Patch *et al.* (1942) found that plants infested early in their development suffered greater yield reduction than those infested later.

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It is the scientist's mission not only to cover nature but also to interpret his results to his fellowmen. Scientific knowledge is itself neutral. It is the use that is made of it that is good or evil. Decisions concerning that use are not for the scientist alone. The layman must therefore make his own efforts at understanding. To assist him, the scientist must, in turn, be ready to leave his laboratory to act as a guide.

—*Sir Edward V. Appleton*

DDT TREATMENT OF SACK CONTAINERS FOR THE CONTROL OF STORAGE INSECTS OF CORN [1]

G. B. Viado and R. M. Labadan

WITH TWO TEXT FIGURES

Of the eleven species of insects encountered in this study, the most abundant and most destructive were the rice weevil, *Sitophilus oryza* (L.) and the saw-toothed beetle, *Oryzaephilus surinamensis* (L.)

Shelled corn stored in DDT-impregnated gunny sacks for a period of eighteen months were adequately protected from storage insects compared with the control. Among the three concentrations of DDT used (1, 3, and 5 per cent) no significant differences were found.

The treatments in the DDT-impregnated cotton sacks did not show significant differences compared with the control. The container offered much greater resistance to penetration by insects and gave more protection to the grain than the gunny sacks.

The wide fluctuation in the market price of corn is partly attributed to the rapid deterioration of the stored product as a result of insect infestation. Soon after the crop is harvested it is susceptible to the attack of the rice weevil, *Sitophilus oryza* L., the most destructive of the insects affecting stored corn.

No satisfactory and practical method of controlling or preventing infestation of stored corn is practised to any extent in the Philippines. Some farmers store their produce by hanging the unhusked ears upside down on fences or racks in the open or under their house. This method is impractical when dealing with a great bulk of the cereal. The present study was conducted in the laboratory of the Department of Entomology from April, 1956 to November, 1957 to determine the effects of impregnating the sack containers with DDT to control insects affecting stored corn.

MATERIALS AND METHODS

Shelled yellow flint corn was used in the tests. The grain was thoroughly dried for three consecutive days to kill insects in any stage of development that might be in the grain.

Two types of containers, closely woven cotton sacks and ordinary gunny sacks, were used (fig. 1). The sacks, which measured about 25

[1] Central Experiment Station Contribution No. 1960. Part of Research Project No. 909 financed by a grant from the NARIC.

by 40 centimeters, were impregnated with DDT by immersing them momentarily in one, three and five per cent emulsions. They were tagged, hung and thoroughly air-dried before being used. Three kilograms of corn were placed in each sack. The treatments were replicated five times.

Fig. 1.—Gunny sack at left and cotton sack made out of empty flour bag at right were the types of containers used in the test.

The bags were distributed at random in open shelves in a room where several sacks of corn heavily infested with storage insects were kept. The temperature of the room for the duration of the test ranged from 26.6° to 32.2°C. Care was taken that the sacks did not touch each other. Counts of damaged kernels and adult insects and weight of the grain were taken four times at three-month intervals. Each bag was opened and the contents poured into a pan, thoroughly mixed, and 500 kernels taken at random and examined for insect injury. The percentage of damaged kernels, number of adult insects within the bag, and weight of entire contents were taken.

RESULTS AND DISCUSSION

The following species of insects [2] were found in the infested room where the treated sacks were placed for observation:

[2] Most of the specimens, which were sent through Dr. Clare R. Baltazar of the Philippine Bureau of Plant Industry who, at the time was in Washington, were identified by specialists at the U. S. National Museum, Washington, D.C.

(a) *Sitophilus oryza* (L.), rice weevil
Oryzaephilus surinamensis (L.), saw-toothed beetle
Plodia interpunctella (Hbn.), Indian meal moth
(b) *Rhizoptera dominica* (F.), grain borer
Tribolium castaneum (Herbst), red flour beetle
Lasioderma serricorne (F.), cigarette beetle
Laemophloeus pusillus (Schonh.), flat grain beetle
Tenebroides mauritanicus (L.), the Cadelle
Araecerus fasciculatus (Deg.), coffee bean weevil
Carpohilus dimidiatus (F.), corn sap beetle
Sitotroga cerealella (Oliv.), Angoumois grain moth

The insect species under (a) were numerous while those under (b) were in small numbers. Parasitic and predatory insects were also found in small numbers associated with the grain.

Uichanco and Capco (1934) reported 11 species affecting stored corn, namely: *Sitophilus oryza, Tribolium ferrugineum, Alphitobius laevigatus, Oryzaephilus surinamensis, Laemophloeus pusillus, Araecerus fasciculatus, Tenebroides mauritanicus, Attagenus undulatus, Carpophilus dimidiatus, Ephestia elutella,* and *Pyralis farinalis.* In a later paper, Otanes and Karganilla (1942) reported six species of insects attacking stored corn, namely, the rice weevil (*Sitophilus oryza*) and five species of moths, *Sitotroga cerealella, Corcyra cephalonica, Ephestia elutella, Plodia interpunctella,* and *Ephestia kuhniella.*

Effects of the treatments on insect population in the sacks. The mean number of adult *S. oryza* in the different treatments in the two kinds of containers after specified number of months are shown in table 1. The total number of adult, both living and dead, were counted in each container. In the gunny sacks, the highest counts in the treated bags were recorded at 12 months while the highest in the control, at 6 months; in the cotton sacks, the highest in the treated were at 6 months and that in the control at 3 months. The differences between the means in the treated and in the control in all observations were highly significant in the gunny sacks but insignificant in the cotton sacks. The differences between treatments in both kinds of containers were insignificant. Adult population in the cotton containers was very low compared with that in the gunny sacks. It is evident that the coarse weave of the gunny sack was responsible for the entrance of adult beetles which were bred inside the containers. In his study on sack containers impregnated with

one and five per cent DDT by weight, Parkin (1948) found that degree of infestation by adults of *Calandra oryza, Tribolium castaneum, Oryzaephilus surinamensis,* and *Ephestia elutella* after storage of 15 weeks at a mean temperature of 21.3°C and a mean relative humidity of 65 per cent depended upon the closeness of weave of the sacking material and the DDT content of the sack.

The saw-toothed beetle, *Oryzaephilus surinamensis,* was next to *S. oryza* in abundance. Adult counts of this species in the gunny sacks at three and six months showed significant differences between the treated and the control, but not at nine, 12, and 18 months (table 1). The differences between the treated and the control in the cotton sacks were insignificant. There was no significant difference between any pair of DDT concentrations in both gunny and cotton sacks.

Four other species, *R. dominica, T. castaneum, L. serricorne,* and *T. mauritanicus,* were present in considerable numbers in the sacks (table 2). In the gunny sacks, the highest count in the control in *R. dominica* and *T. mauritanicus* was at 12 months. *L. serricorne* was highest in 6 months and *T. castaneum* in 18 months. The population of these four species was much higher in the untreated sacks than in the treated. Adult population of the same species was very low in the cotton containers compared with that in the gunny sacks.

Very few adults of *A. fasciculatus* and *C. dimidiatus* were noted in both containers. The population of *L. pusillus* increased at ten months. A few adults of *P. interpunctella* and *S. cerealella* were also noted. Larvae of these moths were found crawling or pupating on the outside surfaces of the bags. Some other insects which were probably parasitic or predatory were also found associated with the grain.

Effects of the treatments on insect damage to the grain. The differences between the mean percentages of damaged kernels in the DDT-impregnated gunny sacks and the control at six, 12, and 18 months from the start of the test were highly significant (table 3). There was consistent increase in infestation in all the treatments as length of storage was prolonged from three to 18 months but in no case did infestation reach one per cent. At the end of 18 months, 97.56 per cent of the kernels in the control were badly infested (fig. 2).

TABLE 1.—*Mean numbers of adult Sitophilus oryza and adult Oryzaephilus surinamensis in the two kinds of containers after specified number of months*

(A) *Sitophilus oryza*

TREATMENT	GUNNY					COTTON				
	3	6	9	12	18	3	6	9	12	18
DDT 1%	64.2	114.2	89.0	122.6	95.8	20.4	38.4	17.4	14.2	15.4
3%	40.6	88.0	81.6	143.8	34.8	27.4	43.0	15.8	8.2	9.4
5%	56.4	91.0	74.6	133.4	107.8	8.4	34.6	15.2	24.0	3.2
Control	1,282.6	5,596.6	2,883.8	1,801.4	883.0	29.4	25.8	11.8	16.8	4.0
S.M.D. (T) 5% =	581.13	1,169.25	290.89	368.47	167.56	a	a	a	a	a
1% =	814.76	1,639.31	407.84	516.60	234.92					

(B) *Oryzaephilus surinamensis*

TREATMENT	GUNNY					COTTON				
	3	6	9	12	18	3	6	9	12	18
DDT 1%	82.6	50.4	28.2	15.4	6.0	4.0	12.8	1.2	2.8	1.6
3%	59.0	32.6	34.8	17.6	18.8	6.0	12.8	0.8	3.4	0.8
5%	36.2	21.4	23.2	23.8	14.4	1.2	7.4	0.6	0.8	0.8
Control	191.0	121.2	105.8	9.6	31.2	7.8	9.4	0.8	1.4	0.4
S.M.D. (T) 5% =	72.24	69.74	a	a	a	a	a	a	a	a
1% =	101.43	98.06								

[a] Not significant.

TABLE 2.—*Total number of adults in the gunny and cotton sacks after specified number of months*

A. *Gunny*

TREATMENT	RHIZOPERTA DOMINICA			TRIBOLIUM CASTANEUM			LASIODERMA SERRICORNE			TENEBROIDES MAURITANICUS		
	6	12	18	6	12	18	6	12	18	6	12	18
DDT 1%	20	5	23	28	18	105	9	0	0	6	8	4
3%	10	13	16	45	35	79	36	2	0	8	17	1
5%	127	13	31	24	28	113	11	0	0	4	9	1
Control	1,444	2,193	477	96	88	144	161	160	0	9	23	17

B. *Cotton*

TREATMENT	RHIZOPERTA DOMINICA			TRIBOLIUM CASTANEUM			LASIODERMA SERRICORNE			TENEBROIDES MAURITANICUS		
	6	12	18	6	12	18	6	12	18	6	12	18
DDT 1%	5	1	3	13	18	9	2	0	0	5	10	2
3%	3	1	0	33	35	5	4	2	0	9	7	0
5%	3	5	1	8	28	1	2	0	0	2	11	0
Control	1	4	1	34	88	3	142	160	212	3	27	4

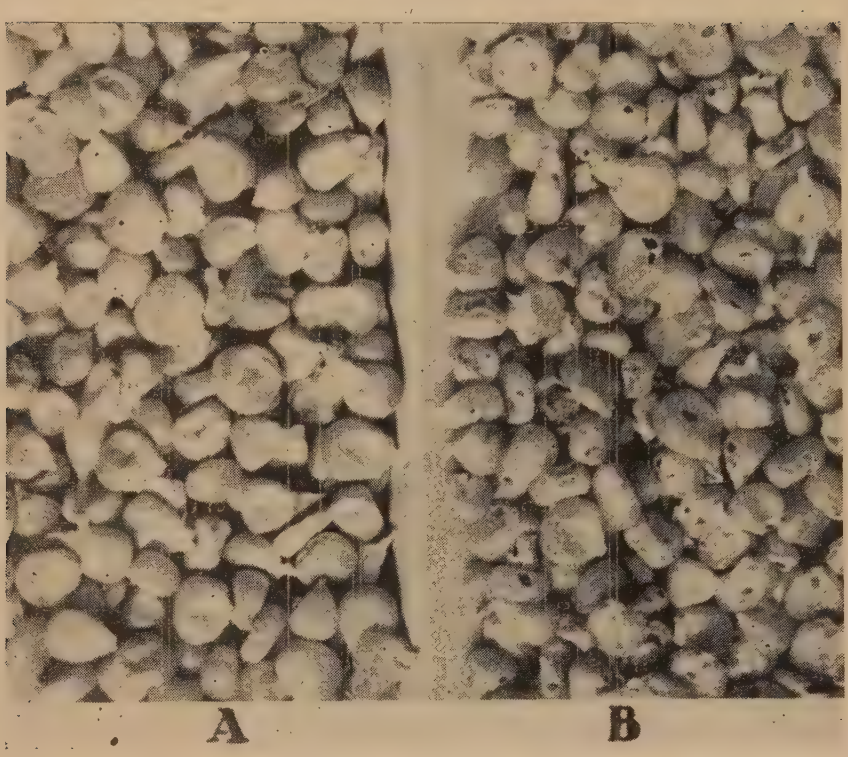

Fig. 2.—Grain from the DDT-treated (A) and the control or untreated (B) gunny sacks at the end of the test. Note damage by *Sitophilus oryza* on the control.

The kernels in the cotton sacks were slightly infested at the end of 18 months. The differences between any of the DDT treatments and the control were not significant at six and 18 months but significant at 12 months. The infestation in the control at 18 months was only 0.8 per cent. The container offered greater resistance to penetration by insects than the gunny sacks. There was no significant difference between the treatments in both the gunny and cotton sacks.

While good control of infestation was obtained in all the treatments (one, three, and five per cent DDT) in the present study, some investigators reported varying results. Jewett and Price (1951) found that bags impregnated with 2.5 per cent DDT solution gave very little protection to corn from grain insects. Bags treated with 5 per cent solution offered much greater resistance to penetration by

TABLE 3.—*Mean percentages of damaged kernels in the gunny and cotton sack containers after specified number of months*

TREATMENT	GUNNY						COTTON					
	6		12		18		6		12		18	
	Actual	Angle	Actual	Angle	Actual	Angle	Actual	Angle	Actual	Angle	Actual	Angle
DDT 1%	0.04	0.51	0.28	2.26	0.68	4.89	0.04	0.51	0.04	0.51	0.56	3.83
3%	0.12	1.54	0.20	1.15	0.72	4.85	0.04	0.51	0.12	1.24	0.20	1.96
5%	0.08	1.02	0.56	3.08	0.88	5.22	0	0	0.12	1.24	0.40	2.23
Control	74.92	63.23	97.00	82.89	97.56	82.12	0.16	1.40	0.76	4.79	0.80	4.85
S.M.D. (T) 5% =	12.21		5.88		3.05			[a]		2.33		[a]
1% =	17.10		8.25		4.28					3.26		

[a] Not significant.

insects and gave fair protection for about 12 months while those treated with 10 per cent gave very good protection for 18 months. In India, Misra (1951) reported that a concentration of 0.65 per cent DDT on sack was effective against flour beetle for 10 months and a concentration of 0.31 to 1.72 per cent produced high kills of rice weevil for 15 months. DDT emulsion-gum arabic solution on jute bag surface was found by Jones (1947) to be toxic to *Tribolium castaneum, Calandra oryza, Rhizoptera dominica* and *Laemophloeus* spp. for about two months.

Effects of the treatments on the weight of the grain. The difference in weight of the grain in the gunny sacks in the various DDT treatments and the control was significant in all the three periods of observation (table 4). The difference in weight between the DDT treatments, however, was insignificant. The loss of weight of the various DDT treatments was slight compared with that of the control. In the cotton sacks, the differences in weight between the treated and the control were insignificant. The loss of weight in both the treated and control was very slight indicating that the treatment did not affect infestation significantly. It is evident that the closeness of weave of the sacking material was an important factor in preventing infestation, at least in the cotton sacks. The slight decrease in weight from the start of the test (original weight was three kilograms) up to 18 months may be attributed largely to loss of moisture.

TABLE 4.—*Mean weight of grains in kilograms in the gunny and cotton sack containers after specified number of months*

TREATMENT	GUNNY			COTTON		
	6	12	18	6	12	18
DDT 1%	2.97	2.95	2.75	2.98	2.92	2.78
3%	2.93	2.84	2.74	2.94	2.91	2.88
5%	2.99	2.85	2.82	2.99	2.89	2.81
Control	2.48	2.34	1.69	2.99	2.95	2.89
S.M.D. (T) 5% =	0.21	0.43	0.21	[a]	[a]	[a]
1% =	0.30	0.61	0.30			

[a] Not significant.

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* * *

The spirit of science is in harmony with the finest ideals of character, for the scientific worker needs such qualities as patience, disinterestedness, earnestness, honesty, diligence, and system. He must be impartial, fairminded and devoid of prejudice. He must be bold in venturing into new fields, stout-hearted in defending his conclusions, and brave in admitting error. He must be tolerant and teachable.

—*Stevens, Hamacher & Smith*

AN ECONOMIC ANALYSIS OF THE METHODS OF FARM FINANCING USED ON 5,144 FARMS [1]

LEOPOLDO P. DE GUZMAN

WITH TWO TEXT FIGURES

Of 5,144 farmers studied, 74 per cent used credit and 26 per cent did not. Fifty-seven per cent of all farmers used store credit, 43 per cent used short-term credit, and 6 per cent used long-term credit.

Short-term loans were extended mostly by private individuals and landlords. The average short-term obligation of borrowers was ₱130. The average rate of interest for all loans was 28 per cent per annum. The size of short-term obligation increased with the increase in size of farm and number of persons in the household. Sixty-three per cent of the loans were fully repaid; 13 per cent partly repaid; and 24 per cent wholly unpaid. Large size of farm was associated with successful repayments of loans.

Store credit was used mainly for obtaining food supplies and by most farmers during the production months. The long-term mortgage loans were mostly secured by real estate. Private lenders provided 44 per cent of the loans and relatives supplied 38 per cent. The median size of long-term mortgage loans was from ₱210 to ₱300. More than one-half of the farmers were not aware of the existence of the rural banks and the Rehabilitation Finance Corporation. The major reason for not borrowing from established credit institutions was lack of available loan collateral.

A shortage of credit on terms reasonable as to interest and repayment continues to inhibit the improvement of Philippine agriculture. This was recognized in the report of a survey mission on agriculture which states:

> "Under the present system of credit and production, the farmer lives on such a close margin between what he produces and what he requires for sheer existence that he cannot afford the risk of investing even in improved methods and materials." [2]

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[1] Central Experiment Station Contribution No. 1961. Part of Project 657. The author acknowledges the help of the staff members of the Departments of Agricultural Economics of the University of the Philippines and the University of Florida.

[2] *Report of the Philippine–United States Agricultural Mission*, Washington: U.S. Department of Agriculture (1947).

In their survey of rural households in Central Luzon in 1952, Rivera and McMillan noted the following characteristics of agricultural credit: scarcity of loanable funds or commodities, exhorbitant interest rates, and almost exclusive monopoly of private money lenders and landlords as sources of credit.[3]

The first step in improving the rural credit system is to study it thoroughly. Data on the nature and factors related to sources, terms, costs and repayment of credit for farmers in the Philippines is necessary for policy-makers in allocating agricultural credit resources and making other desirable adjustments in lending procedures. Such information may also help private banks and other lenders in adjusting their lending policies to the peculiar needs of agriculture. An evaluation of the factors related to loan repayments can be of value to both borrower and lender for successful loan repayments.

THE STUDY

This study was undertaken to provide basic information on (a) the methods by which farmers meet their credit needs; (b) the factors affecting the amount of credit required and its costs; and (c) the factors which affect loan repayment. It was conducted by the Department of Agricultural Economics of the U. P. College of Agriculture from April, 1954 to June, 1955. The information was obtained by thirty-eight thesis students and six staff members who covered 25 provinces and interviewed 5,344 farmers (table 1). The sample was reduced to 5,144 farms when the records were processed.

The results of this study in a rigorous statistical sense can be said to be representative only of the group of farmers interviewed. It is believed, however, that the results are generally representative of the Philippines and individual provinces therein.

USE OF CREDIT

Among the 5,144 farmers included in the study only 26 per cent did not obtain any form of credit (table 2). More than one-half of all farmers used store credit. Forty-three per cent of the farmers obtained short-term loans and six per cent, long-term loans.

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[3] Generoso F. Rivera and Robert T. McMillan, *"An Economic and Social Survey of Rural Households in Central Luzon,"* Cooperative Research Project of the Philippine Council for United States Aid and the United States of America Operations Mission to the Philippines, Manila (1952).

TABLE 1.—*Number of farmers interviewed, by region*

REGION	NUMBER OF FARMERS
Ilocos (Abra, Ilocos Norte, Ilocos Sur, La Union)	417
Cagayan (Isabela)	102
Central Luzon (Bataan, Bulacan, Nueva Ecija, Pampanga, Pangasinan, Rizal, Tarlac, Zambales)	1,807
Southern Luzon (Batangas, Cavite, Laguna, Quezon)	1,642
Bicol (Albay, Camarines Sur)	537
Visayas (Capiz, Cebu, Leyte)	327
Mindanao (Agusan, Davao, Surigao)	312
Total	5,144

TABLE 2.—*Per cent of farms using different types of credit, by region* [a]

REGION	PER CENT OF TOTAL FARMERS [b]			
	Non-borrowers	Store borrowers	Short-term borrowers	Long-term borrowers
Ilocos	55	24	30	11
Cagayan	24	39	59	23
Central Luzon	28	54	52	4
Southern Luzon	16	66	42	3
Bicol	24	67	41	9
Visayas	15	67	43	16
Mindanao	39	45	19	5
Total	26	57	43	6

[a] 5,144 farms included.
[b] Some farmers used more than one type of credit.

There were wide variations among the different regions in the proportion of farmers using credit as well as in the use of the different types of credit. For example, there were only 16 per cent of the farmers in Southern Luzon who did not obtain credit compared to 55 per cent in Ilocos. In Central Luzon, 52 per cent of the farmers obtained short-term loans compared to 30 per cent in Ilocos and 19 per cent in Mindanao. Store credit was used by two-thirds of the farmers in Southern Luzon, Bicol and Visayas compared to almost one-third in Ilocos and Cagayan.

SHORT-TERM LOANS

Short-term loans ordinarily have a period of repayment of one year. In this study, however, it was convenient to include loans which provide for repayment within three years. Actually, only 10 per cent of the loans so classified had a repayment period of over one year.

Number of loans per borrower. In 82 per cent of the sample, a farmer had only one short-term loan (table 3). The other 18 per cent had more than one loan.

TABLE 3.—*Number of short-term loans per borrower, by type of farming* [a]

TYPE OF FARMING	NUMBER OF FARMS	NUMBER OF LOANS PER BORROWER				
		One loan	Two loans	Three loans	Four or more loans	Total
				per cent		
Lowland rice						
One crop	838	84	12	3	1	100
Two crops	419	71	23	5	1	100
Upland rice	173	90	7	2	1	100
Coconut	45	87	11	2	—	100
Sugar cane	60	64	15	10	11	100
Corn	24	96	4	—	—	100
Tobacco	13	92	—	8	—	100
Vegetables	11	91	9	—	—	100
Combination of two crops	120	86	12	2	—	100
General	248	86	10	3	1	100
Other enterprises	13	69	23	—	8	100
All farms	1,964	82	14	3	1	100

[a] 1,964 farms included.

It is interesting to note that among the different types of farmers, relatively more of those raising two crops of lowland rice and sugar cane obtained two or more loans. Sugar cane farmers and farmers raising two crops of rice ranked first and fourth respectively, among 11 types of farms in terms of family farm labor earnings.[4] One logical explanation for this is the occurrence of two production periods in double-crop rice farming which requires cash expenditures. In sugar cane farming, the original high cash expenses and the long growing period (from 10 to 14 months) make borrowing for production and consumption necessary.

[4] Family farm labor earnings represents the returns, both in cash and in farm privileges, from farming to all working members of the family including the operator.

Source of loans. The major sources of short-term loans were private individuals and landlords who accounted for 42 and 39 per cent of the total number, respectively (table 4). The Agricultural Credit and Cooperative Financing Administration (ACCFA) which was on its second year of operation, accounted for 11 per cent of the loans. Relatives, merchants, commercial banks (including the rural banks) and other lenders accounted for eight per cent of the loans.

TABLE 4.—*Source of short-term loans, by regions* [a]

SOURCE OF LOAN	ALL REGIONS		ILOCOS	CAGAYAN	C. LUZON	S. LUZON	BICOL	VISAYAS	MINDANAO
	No. of loans	Per cent							
						per cent			
Landlord	936	39	4	—	40	59	24	14	16
Private individual	993	42	39	100	33	30	65	62	69
ACCFA	260	11	37	—	21	2	9	—	—
Relative	148	6	18	—	4	9	1	5	6
Merchant	34	1	—	—	[b]	—	—	18	1
Government agency	8	[b]	1	—	[b]	[b]	—	—	—
Bank	24	1	—	—	2	[b]	1	1	1
Insurance company	8	[b]	1	—	—	—	[b]	—	7
Total	2,411	100	100	100	100	100	100	100	100

[a] 2,411 loans included.
[b] Below one per cent.

In all of the regions except Central Luzon and Southern Luzon, private lenders were the major source of loans. In these two regions, landlords were relatively more important. ACCFA operations were more concentrated in Central Luzon and Ilocos where they provided a significant proportion of loans.

Type of short-term loans. The most common type of short-term loans was cash. Cash loans were equal to 85 per cent of the number (table 5). Loans in kind, mostly in the form of rice, were equal to 13 per cent, while combinations of cash and commodity were equal to two per cent.

The low percentage of loans in kind indicates that commodity advances from landlords were not very common. The provision in some tenancy arrangements for loans in kind from the landlord was noted by several writers.

Size of a short-term loan. The average size of 2,411 short-term loans was ₱105 (table 6). The average size ranged from ₱79 for

TABLE 5.—*Type of short-term loans* [a]

TYPE OF LOAN	NUMBER OF LOANS	PER CENT
Cash	2,062	85
Commodity:		
Rough rice	233	10
Polished rice	42	2
Others	13	1
Cash and rough rice	31	1
Cash and polished rice	25	1
Others	3	[b]
Total	2,409	100

[a] 2,409 loans included.
[b] Below one per cent.

TABLE 6.—*Average size of individual short-term loans by source of loans* [a]

SOURCE OF LOAN	NUMBER OF LOANS	AVERAGE LOAN VALUE
Landlord	936	₱100
Private individual	993	79
ACCFA	260	177
Relative	148	106
Merchant	34	87
Government agency	8	252
Bank	24	596
Insurance company	8	129
All loans	2411	₱105

[a] 2,411 loans included.

loans from private money lenders to ₱596 for bank loans. In general loans from private unlicensed lenders were much smaller than those from established credit institutions.

Total short-term obligation per farm. As mentioned earlier some farmers had more than one loan. The average total short-term obligation of each farmer was ₱130 (table 7). Borrowers in Central Luzon borrowed an average of ₱162 compared to ₱62 in Cagayan and ₱46 in Mindanao.

Short-term credit also differed greatly between types of farms. As shown in table 8, sugar cane farmers had the highest average short-term obligation, equal to ₱410. Farmers dependent on one crop of rice had a lower average total short-term obligation than those growing two crops. Although sugar cane farmers and farmers who raised two crops of rice had the highest average short-term

TABLE 7.—*Average size of total short-term obligation per farm, by region* [a]

REGION	NUMBER OF FARMS	AVERAGE TOTAL SHORT-TERM OBLIGATION
Ilocos	166	₱122
Cagayan	56	62
Central Luzon	724	162
Southern Luzon	636	126
Bicol	220	110
Visayas	149	83
Mindanao	62	46
All regions	1,963	₱130

[a] 1,963 farms included.

TABLE 8.—*Average size of total short-term obligation per farm by type of farming* [a]

TYPE OF FARMING	NUMBER OF FARMS	AVERAGE TOTAL SHORT-TERM OBLIGATION
Lowland rice		
One crop	839	₱127
Two crops	419	139
Upland rice	173	82
Coconut	45	97
Sugar cane	60	410
Corn	24	21
Tobacco	13	71
Vegetables	11	51
Combination of two enterprises	120	92
General	248	129
Other major enterprises	11	166
Average	1,963	₱130

[a] 1,963 farms included.

obligation, their incomes were also among the highest. This may mean that these farmers were more efficient in the use of credit resources than the others.

Interest rate per annum. In computing the interest rates for commodity and cash loans repaid in kind, the value of the commodities rather than the physical quantity was used. This arrangement reduces the effect of price fluctuations in the market system and more truly reflects the cost of lending. Thus, a lender who lends out a cavan of rice in the "tight period" when it is valued at ₱10 and is repaid with two cavans, earns an interest of ₱2 if price per cavan dropped down to ₱6 during the time of repayment.

Of the 2,412 short-term loans, 49 per cent did not provide for any interest payments (table 9). The other half, however, had interest rates from 3 per cent to over 300 per cent per annum. One-fourth of the loans had interest rates higher than 20 per cent per annum.

TABLE 9.—*Short-term loan interest rate per annum, by region* [a]

INTEREST RATE IN PER CENT PER ANNUM	ALL REGIONS		ILOCOS	CAGAYAN	C. LUZON	S. LUZON	BICOL	VISAYAS	MINDANAO
	No. of loans	Per cent							
						per cent			
None	1,182	49	49	—	38	69	30	50	92
1– 9	119	5	1	—	2	8	5	2	1
10– 19	481	20	45	2	34	10	17	2	1
20– 49	255	11	3	4	13	9	8	20	6
50– 99	148	6	2	5	7	2	10	23	—
100–149	110	4	—	47	3	1	14	2	—
150–199	43	2	—	16	1	[b]	5	1	—
200–299	48	2	—	20	1	[b]	7	—	—
300–over	26	1	—	6	1	1	4	—	—
Total	2,412	100	100	100	100	100	100	100	100

[a] 2,412 loans included.
[b] Below one per cent.

Among the different regions Mindanao and Southern Luzon had the highest proportion of loans with no interest rates. Cagayan and Bicol, on the other hand, had relatively more loans with interest rates. Also, in these two regions, 89 and 30 per cent of the loans, respectively, had interest rates of at least 100 per cent per annum.

The average interest rate of the 2,412 short-term loans was 28 per cent per annum. Despite the large number of loans with no interest rates, the average was also two times the legal maximum. The average interest rate for those loans with interest rates was 55 per cent per annum.

The extent to which the interest rates varied between sources of loans is shown in table 10. Loans from landlord and private lenders showed wide extremes. More than one-half (53 per cent) of the landlord loans had no interest rates but 25 per cent had interest rates from 20 to more than 300 per cent per annum. The same trend was true for loans from private money lenders; only slightly more loans were in the high interest classes.

TABLE 10.—*Short-term loan interest rate per annum, by source of loan* [a]

SOURCE OF LOAN	INTEREST RATE PER ANNUM						
	None	1-9	10-19	20-49	50-99	100-over	Total
Landlord	53	8	14	14	6	5	100
Private individual	51	3	7	12	9	18	100
ACCFA	—	[b]	100	—	—	—	100
Relative	92	—	3	3	2	—	100
Merchant	94	—	—	3	3	—	100
Government agency	38	50	12	—	—	—	100
Bank	—	28	72	—	—	—	100
Insurance company	—	100	—	—	—	—	100
All loans	49	5	20	11	6	9	100

[a] 2,412 loans included.
[b] Below one per cent.

Some of the loans from landlords with no interest rates are considered as the landlord's obligation in the tenancy contracts. In some cases, however, for loans beyond the landlord's obligations in such tenancy contracts interest in kind is usually charged. In the case of loans from private lenders, the high proportion of loans with no interest rates and the fact that loans from private individuals were smallest in size, may mean that friends and neighbors provided a significant number of small personal loans. It is probable that the loans from private money lenders with high interest rates were those extended by landlords of other tenants, and professional money lenders who had a relatively smaller control over the borrower's harvest.

Interest on ACCFA loans as well as those from banks are limited by law to 12 per cent per annum as the maximum. Loans from merchants are usually tied up with the method of sale of the borrower's crop. Loans from relatives in most of the cases did not bear interest rates.

Security offered. Adequate security for the loan is usually required as a means of reducing the risk of loss to the lender from non-payment of the loan. In this study, 85 per cent of the loans had no security. The remaining 15 per cent were secured with promissory notes and chattel mortgages. The predominance of short-term loans without interest and security attests to the personal nature of short-term lending.

Months of borrowing and repayments. The data on 2,295 short-term loans indicate that borrowings reached their peak in May and

June (fig. 1). These months coincided with the start of the rainy season when farmers began preparing land for cultivation. Months of high [5] borrowing included May, June, July, August, September, and December.

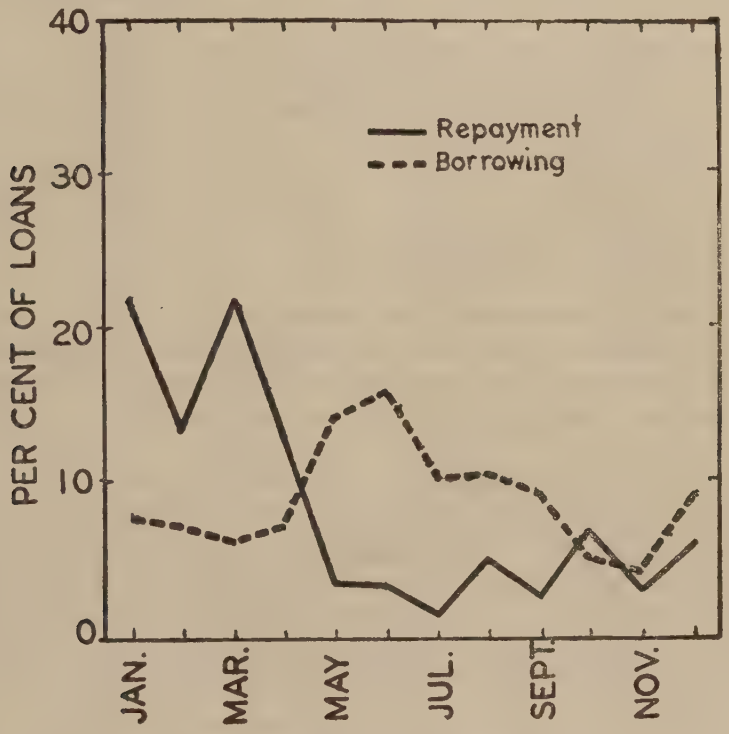

Fig. 1.—Months of borrowing and repayment of 2,295 short-term loans.

Short-term loans are usually repaid after the crop harvest. In this study, the months of highest loan repayments were from January to March. These were the harvest months for most rice farms. The differences in the crop growing period among the regions for one type of farm, as well as among different types of farms, resulted in not as consistent a trend in repayments as was found in borrowings.

[5] High refers to percentage of borrowing beyond 8.3 per cent for a particular month. If loans were evenly distributed among the 12 months, the percentage distribution would be 8.3 per cent per month.

Period of the loan. The average contractual period for the repayment of short-term loans was 6.7 months. However, this varied considerably between regions as shown in table 11.

TABLE 11.—*Average period of short-term loans, by region* [a]

REGION	NUMBER OF LOANS	AVERAGE PERIOD OF LOAN IN MONTHS
Ilocos	119	6.8
Cagayan	81	5.6
Central Luzon	870	8.3
Southern Luzon	825	7.1
Bicol	272	7.1
Visayas	175	5.5
Mindanao	70	2.4
All regions	2,412	6.7

[a] 2,412 loans included.

Except for the farm improvement loans of the ACCFA and some bank loans, most of the loans provided for payments during harvest time. A large number of loans had indefinite periods of repayment, but these were generally repaid at harvest time.

FACTORS ASSOCIATED WITH SHORT-TERM LOANS

Factors Affecting Size of Short-term Obligation

a. *Size of farm.* Size of farmland was found to be directly related to size of short-term obligation (table 12). Farmers with farms less than one hectare had an average total short-term obligation of ₱75 compared to an average of ₱130 for all farmers, and ₱304 for farmers with farms of five hectares or more.

TABLE 12.—*Average size of total short-term obligation per farm by size of farm* [a]

HECTARES OF CROPLAND	NUMBER OF FARMS	AVERAGE TOTAL SHORT-TERM OBLIGATION
Below 1.0	187	₱ 75
1.0–1.9	570	83
2.0–2.9	520	112
3.0–3.9	290	139
4.0–4.9	155	182
5.0–over	202	304
All farms	1964	130

[a] 1,964 farms included.

b. *Size of borrower's household.* The number of persons in the borrower's household, as well as their age and sex, is a factor in lending generally considered by lending institutions because the bor-

rower's first obligation is to feed and clothe his family. In this study there appears to be a reasonably direct relationship between the amount of total obligation and the number of persons in the household. Households with just one or two members had an average loan of ₱84, compared to ₱198 for families with at least nine members (table 13).

TABLE 13.—*Average size of total short-term obligation per farm, by number of persons in the household* [a]

NUMBER OF PERSONS IN HOUSEHOLD	NUMBER OF FARMERS	AVERAGE TOTAL SHORT-TERM OBLIGATION
1–2	95	₱ 84
3–4	461	115
5–6	627	104
7–8	514	149
9–over	259	198
All borrowers	1956	₱130

[a] 1,956 farms included.

Factors Affecting Interest Rates

a. *Size of the loan.* The size of the loan and interest rates per annum were found to be inversely related. For 1,914 short-term loans, which did not include the interest-free loans from landlords, the highest interest rates were charged for loans below ₱20 and the lowest for loans of ₱500 and over (table 14). An average of 55.4

TABLE 14.—*Interest rate per annum and period of short-term loans, by size of loan* [a]

SIZE OF LOAN IN PESOS	NUMBER OF LOANS	AVERAGE INTEREST RATE PER ANNUM	AVERAGE PERIOD OF LOAN
		per cent	*months*
Below 20	281	55.4	4.8
20– 49	451	45.0	6.1
50– 99	528	30.4	6.4
100–149	218	29.5	6.5
150–199	120	29.1	8.1
200–299	147	21.3	8.7
300–399	89	16.3	16.7
400–499	27	15.7	11.0
500–over	53	14.4	11.6
All loans	1914	36.5	7.1

[a] 1,914 loans included.
[b] Loans from landlord with no interest rates were not included in this table.

per cent per annum was charged for loans below ₱20 while for loans of ₱500 or more the interest rate averaged 14.4 per cent per annum.

The inverse relationship between size of loan and the interest rate may be due to the higher costs of collecting small loans, and perhaps, to greater risk of small loans. It is likely that a smaller proportion of the small loans was adequately secured than that of the large loans, making risk greater for small loans. Also, the problem of loan collection is greater for a number of small borrowers than for one large borrower.

b. *Period of the loan.* As shown in table 14 the period of the loan increased with the size of the loan, while the interest rate per annum gradually decreased. Loans smaller than ₱20 had an average period of 4.8 months and an average interest rate of 55.4 per cent per annum compared to 11.6 months and 14.4 per cent for loans of ₱500 or more. Except for loans above ₱399, the inverse relationship of interest rate and loan period was consistent.

Loan repayments. The percentage of the loans that were fully repaid was 63 per cent (table 15). Partial repayment was equal to 13 per cent while non-repayment was equal to 24 per cent. To find out some factors which affect loan repayments, the following were sorted by repayment status: (a) operator's labor earnings per farm and per hectare; (b) family farm labor earnings per farm and per hectare; and (c) size of farm. Only the size of farm showed a distinct relationship to loan repayment.

TABLE 15.—*Loan repayment status of 1955 borrowers*

REPAYMENT STATUS	NUMBER OF BORROWERS	PER CENT
Loans fully repaid	1235	63
Loans partly repaid	247	13
Loans wholly unpaid	473	24
All borrowers	1955	100

Size of farm. As shown in table 16, an increase in the size of farm up to 4 hectares was accompanied by a decrease in percentage of total obligation outstanding. For farms of 4 hectares or more in size, the percentage unpaid balance is of the total obligation increased with the increase in farm size.

TABLE 16.—*Per cent unpaid balance of total short-term loan obligation, by size of farm* [a]

HECTARES OF CROPLAND	NUMBER OF FARMS	PER CENT UNPAID BALANCE IS OF TOTAL LOAN OBLIGATION
Below 1.0	187	53
1.0–1.9	570	50
2.0–2.9	560	39
3.0–3.9	290	38
4.0–4.9	155	39
5.0–over	202	60
All farms	1964	54

[a] 1,964 farms included.

The inverse relationship between the percentage of unpaid balance outstanding and the size of farm for farms less than 4 hectares in size may mean that small farm operators had a relatively smaller amount of their income available for loan repayments. As the size of farm increased, that part of the total income available for debt repayment might have increased. However, farmers operating farms of 4 hectares or more had obtained relatively larger loans which had longer maturity periods.

STORE CREDIT

Items bought. Among 2,920 farmers who reported the items they bought on store credit, food supplies was the most common. These were reported by 91 per cent of the farmers (table 17). The other items purchased on store credit include supplies for the farm, school supplies for the children, fiesta supplies, clothing and miscellaneous items.

TABLE 17.—*Items bought on store credit* [a]

ITEMS BOUGHT ON STORE CREDIT	NUMBER OF FARMERS	PER CENT OF TOTAL FARMERS [b]
Food	2,654	91
School supplies	491	17
Fiesta supplies	383	13
Clothing	343	12
Farm supplies	580	20
Miscellaneous	745	26

[a] 2,920 farmers using store credit were included.
[b] Percentage based on 2920.

Seasonality of borrowing and repayment. The use of store credit by farmers showed a marked seasonal fluctuation. This was likewise true for repayment of store credit. June, July, August, and September were the months when the greatest proportion of the farmers used store credit (fig. 2). These are the crop production months in most regions and also the period of high cash expenditures. On the other hand, during the months when the crops are harvested a lower proportion of the farmers used store credit.

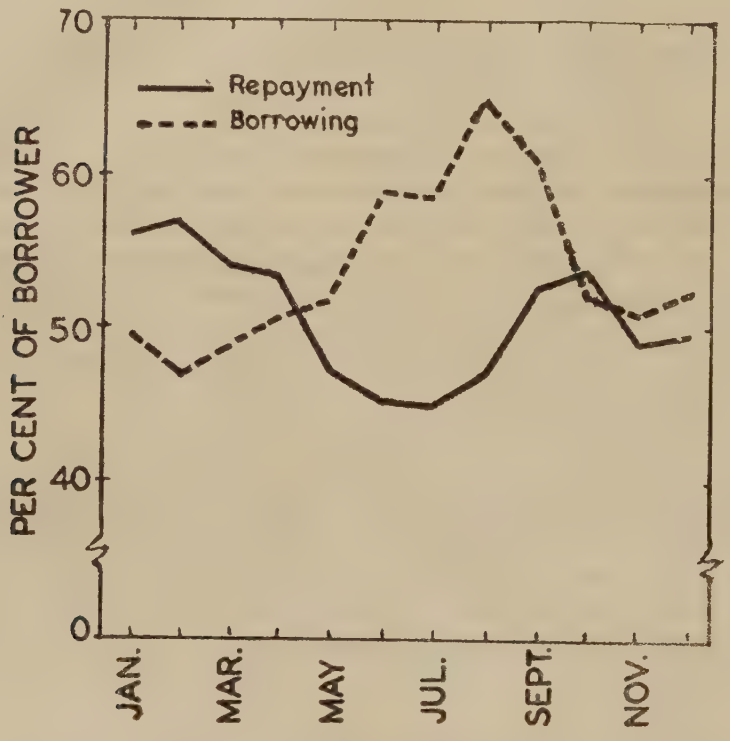

Fig. 2.—Months of borrowing and repayment of store credit by 2,233 farmers.

Months when the greatest proportion of the farmers repaid their store borrowings were January, February, March, and October. The first three months constitute the harvest season for wet-season lowland rice and upland rice. October is the month when most of the second crop of lowland rice is harvested.

Repayment terms. Store bills were generally repaid in cash. Repayments in cash were reported by 88 per cent of the borrowers,

while five per cent reported repaying in cash and in kind. The method of repayment was not reported by seven per cent of the farmers.

Some store owners require the borrower to sell his crop to the store. This arrangement enables some store owners to buy the crop at a lower price. In this study 11 per cent of the farmers using store credit were under obligation to sell their crops to the store owner. This requirement generally applies to borrowers who have accumulated large store bills and whose repayment funds will come from the next harvest.

LONG-TERM MORTGAGE LOANS

Long-term mortgage loans as defined for purposes of this study, include (a) mortgage loans with a definite period of repayment of more than 3 years, and (b) mortgage loans for which the repayment period was indefinite but which in most cases was known to exceed three years. Long-term mortgage loans for which information as to the term of the loan was obtained totalled 294,[6] of which 201 had an indefinite period of repayment.

Property mortgaged. Of 288 long-term mortgage loans, 274 or 96 per cent, were secured with real estate (table 18). Jewelry, work animals, a farmer's house, and a house with a lot were used as the loan security for the remaining four per cent. This strong preference for land as an item of security was one reason why long-term loans were relatively more common in areas where there was a high percentage of owner-operators and part-owners.

TABLE 18.—*Kind of property mortgaged* [a]

PROPERTY MORTGAGED	NUMBER OF LOANS	PER CENT
Real estate	274	96
Jewelry	5	2
Work animal	7	2
House	1	b
House and lot	1	b
Total	288	100

[a] 288 long-term mortgage loans included.
[b] Below one per cent.

[6] There were four additional loans for which terms of loan were not reported.

Source of loans. The major sources of long-term mortgage loans as shown in table 19 were private individuals and relatives who accounted for 45 and 38 per cent of the number of loans, respectively. Commercial banks, including the Philippine National Bank and the Rehabilitation Finance Corporation, accounted for eight per cent of the number of loans, while loans from landlords, businessmen, pawn shops and other sources comprised nine per cent.

TABLE 19.—*Source of long-term loans* [a]

SOURCE OF LOAN	NUMBER OF LOANS	PER CENT
Relatives	113	38
Private individuals	137	45
Businessmen	13	4
Philippine National Bank	2	1
Rehabilitation Finance Corp.	2	1
Other banks	18	6
Landlord	5	2
Pawn shops	2	1
Others	6	2
Total	298	100

[a] 298 loans included.

Purpose of loans. Of the 298 long-term mortgage loans, 18 per cent were obtained for production purposes; 46 per cent for family subsistence, education of the children, medical needs and other emergencies; and 20 per cent, for other purposes (table 20).

TABLE 20.—*Purpose for borrowing long-term mortgage loans* [a]

PURPOSE FOR BORROWING	NUMBER OF LOANS	PER CENT
Family subsistence	49	16
Education of children	42	14
Medical needs	29	10
Purchase of farm capital items	26	9
House construction and repairs	22	7
Emergency needs	17	6
Farming expenses	14	5
Business	11	4
Social obligations	12	4
Combination of purposes	61	20
Not ascertained	15	5
Total	298	100

[a] 298 loans included.

The other purposes reported by the borrowers include expenses for house repair and construction, and expenses for social obligations such as weddings, baptisms, and funerals. In five per cent of the loans the purpose for borrowing was not reported.

Size of loans. The size of loans varied widely so that an arithmetic average would not be fairly representative. The size ranged from less than ₱50 to more than ₱3,010 (table 21). The modal group was from ₱110 to 200, while the median group was from ₱210 to ₱300. However, 48 per cent of all the loans was more than ₱300.

TABLE 21.—*Size of long-term mortgage loans* [a]

AMOUNT OF LOAN IN PESOS	NUMBER OF LOANS	PER CENT
50–below	30	10
60–100	34	11
110–200	60	21
210–300	31	10
310–400	22	7
410–500	29	10
510–900	40	13
910–3000	44	15
3000–over	8	3
Total	298	100

[a] 298 loans included.

Interest rates. The data on interest rates were believed to be inaccurate because of the nature of some of the mortgage terms. For instance, in mortgage loans where the borrower pays a part of the crop to the lender, the lack of data on the crop share given to the lender, and the difficulty of classifying the crop payment as either interest or land rent, resulted in interest rates not being ascertained.

Period of the loan. The majority of the borrowers (68 per cent) reported that there was no definite period for repaying the loan (table 22). Loans providing for repayments in four to six years

TABLE 22.—*Maturity period of 294 long-term mortgage loans*

LOAN PERIOD, YEARS	NUMBER OF LOANS	PER CENT
Indefinite	201	68
4–6	73	25
7–9	5	2
10–over	15	5
Total	294	100

accounted for 25 per cent of all loans, while loans providing for a repayment period of seven to 12 years accounted for seven per cent.

OTHER INFORMATION

The low proportion of farms using governmental credit agencies might be due, among other reasons, to ignorance of the existence of these agencies. Of the total farmers included in the study, 58 per cent had not heard of the Rehabilitation Finance Corporation and the rural banks. Less than one-third of the farmers have not heard of the ACCFA. Of 5,010 farmers, 12 per cent reported being members of Farmers' Cooperative Marketing Associations.

Farmers did not try to borrow from the government credit agencies for various reasons. The major reason, reported by 33 per cent of the farmers, was that they did not have enough collateral (table 23). Sixteen per cent reported that they did not know the borrowing procedures, and seven per cent thought that borrowing from banks was complicated.

TABLE 23.—*Reasons of farmers for not borrowing from credit institutions* [a]

REASONS FOR NOT BORROWING FROM CREDIT INSTITUTIONS	NUMBER OF FARMERS	PER CENT
Does not own enough collateral	1,239	33
Does not need large amount	732	20
Does not know how to borrow	595	16
Borrowing procedure is complicated and takes time	269	7
Afraid of not being able to repay	284	8
Money available from other sources	280	8
Have not heard of lending institution	216	6
Other reasons [b]	99	2
Total	3,714	100

[a] 3714 farmers included.

[b] Include such reasons as: "cannot read or write," "not member of FaCoMa," "high interest rate charged by credit institutions" and "banks are strict."

There were 1,477 farmers who borrowed from landlords before or during the time of the study. Of this number, 90 per cent had no complaints against landlord credit. For the other 10 per cent the complaints were "high interest rates," "low price per cavan set by landlords for commodity repayments," and "strictness of landlords." The high percentage of farmers with no complaints on landlord credit may be due to the comparatively lower interest rates of landlord loans as compared to loans from private lenders.

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